Title

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THE EFFECTS OF GENDER ON COMMUTER BEHAVIOR CHANGES IN THE CONTEXT OF A MAJOR FREEWAY RECONSTRUCTION

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ABSTRACT

To study the commuter travel behavior impacts of a nine-week reconstruction of Interstate 5 (I-5) in downtown Sacramento, California, a series of three internet-based surveys was conducted. This paper offers a preliminary analysis of the first two of those surveys, focusing on the role of gender in commuters' responses. Avoiding rush hour and changing route were the most common responses, and women were more likely than men to employ them. Among the changes that reduce vehicle-miles traveled, increasing transit use and increasing telecommuting were the most common. Overall, women were 21% more likely to make at least one change than men were. A binary logit model of the choice to increase transit use suggests that persuading current transit users to increase their transit use was easier than convincing nonusers to switch. Respondents who heard about the increased level of transit service were more likely to increase transit use. Employer transit subsidies supported increases in transit use (but only for women), while variable work hours (for women) discouraged them. Men in managerial/administration and women in larger households were also more likely to increase their transit use.

Keywords: Gender differences, Behavior change, Mode choice, Transit use, Freeway reconstruction, Transportation Demand Management

1 INTRODUCTION

In the nine weeks between May 30 and July 31, 2008, a one-mile stretch of Interstate 5 (I-5) in downtown Sacramento, California was intermittently closed for a reconstruction project ("the Fix I-5 project", or "the Fix"). This portion of I-5 is part of a major north-south conduit for interregional traffic, as well as a key commute route serving downtown Sacramento (the state capital) and other job locations in the region. To mitigate the impact of the Fix, a number of strategies were implemented by Caltrans and other public agencies, including providing extensive information on the Fix and commute alternatives, increasing transit service, and offering reduced-rate parking at some facilities. Two weeks before the Fix (May 16), Gov. Schwarzenegger issued Executive Order S-04-08 (http://gov.ca.gov/index.php?/press-release/9631/, accessed August 31, 2009) directing State executive agencies to promote commute alternatives for their employees to the fullest extent possible, and encouraging other public agencies and private companies to do the same. The Executive Order also authorized a study of the impacts of the Fix, with a view to evaluating the effectiveness of the commute modification strategies being promoted, and the extent to which more sustainable commute patterns would be the longer-term result. As the interstate highway system and other elements of the transportation infrastructure continue to age, reconstruction projects like Fix I-5 will occur quite frequently. Therefore, it is important to learn as much as possible about commuter reactions to such projects, to enable future projects to be implemented in the most effective way. At the same time, such projects offer valuable opportunities to disrupt habitual behavior in a natural way, and to use that disruption to motivate shifts toward more sustainable commute choices (Gardner, 2009).

For both of these purposes, it is of interest to examine whether there are any significant differences by gender. Do women, with generally more complex activity schedules (Bianco and Lawson, 1996; Hjorthol, 2004), experience adverse impacts of such reconstruction projects more heavily than men? Are they less likely than men to make changes, and if so is it because they have more constraints, or because they have already built in more flexible options such as flextime or telecommuting that allow them to absorb disruptions more robustly? Or are women more likely than men to make changes, and if so, is it because of experiencing more adverse impacts, a generally greater receptivity to change (Dobbs, 2007), or a greater environmental sensitivity (Matthies et al., 2002) giving them a stronger internal motivation to change? The present study can provide some preliminary insights into these questions.

A series of three internet-based surveys was conducted to evaluate the impacts of the Fix on commuter behavior. The present paper offers an initial analysis of the first two of those surveys. Specifically, we address the active choices made by commuters to cope with the closure (e.g. taking vacation, telecommuting, or changing mode), and how those choices may differ by gender. In addition to presenting descriptive statistics, we develop a binary logit model of the most frequently adopted active choice that reduces vehicle-miles traveled (VMT), namely the choice to increase the use of transit during the Fix.

The remainder of the paper is organized as follows. The next section briefly reviews previous related research, and the following section describes the data collection. Subsequently, we discuss descriptive statistics for baseline work schedule/commute characteristics, and the active choices made by commuters. The binary logit model is presented in the penultimate section. The final section summarizes the study and suggests future research directions.

2 LITERATURE REVIEW

Numerous studies have addressed gender differences in various indicators of travel behavior, and likely reasons for those differences. Some key findings (especially in, though not limited to, the U.S. context) include the following:

- Women continue to exhibit shorter commute times and distances than men (Crane, 2007).
- Nationwide, women are (still) more than men likely to commute by transit (Pisarski, 2006), though their transit use has declined over the past 20 years and the picture is more complex when controlling for race (Crane, 2007). In a 1994 stated preference survey of suburban commuters in Montreal, Canada, Patterson et al. (2005) found that women were less likely to choose public transit than men, suggesting that their higher revealed preference shares often represent constrained choices.
- Women do more child-chauffeuring and make more household-serving trips (such as grocery shopping) than men (Mauch and Taylor, 1997, using trip diary data from a 1990 survey of San Francisco Bay Area residents, with similar results found in Norway by Hjorthol, 2004).
- Women are more concerned about safety (Liss et al., 2005), and more likely to take safety considerations into account in making travel choices (Church et al., 2000; Kenyon et al., 2002).

Although women’s travel patterns have changed dramatically over the past few decades, Crane (2007) found persistent gender differences in a nationwide (US) panel study covering the period 1985-2005. One Norwegian study (Hjorthol, 2004) similarly found that gender differences did not diminish during the 1990s, noting that women’s travel distances were (still) more local than men’s, men had more work trips, and women had more non-work trips.

In view of these and other differences, decision-makers have been advised to consider the distinctive travel needs of women and men during transportation planning and operations (Kerkin, 1995; Lu and Pas, 1999). Tranter (1994) pointed out that gender-based role differences influence not only daily travel patterns but economic and social status which in turn affects the choices available for women which consequently affect mobility. The Women's Planning Network Inc. (1995) also indicated that there is an absence of transportation policies directed at women's transport needs. Law (1999) suggested the need for further research on “gender and daily mobility”, incorporating it within a larger theoretical project.

Interestingly, we were unable to find any studies specifically focusing on the subject of this paper: gender-based effects associated with the execution of a planned freeway reconstruction. However, several (linked) literatures are generally relevant. Many or most strategies associated with mitigating the disruption of a freeway reconstruction fall into the category of transportation demand management (TDM) policies, and a sizable literature exists on the adoption and effectiveness of TDM measures. Although TDM policy seldom addresses gender differences in travel behavior, within that field some gender-based observations have been made. For example, Bianco and Lawson (1996) suggested that TDM strategies may be more burdensome on women than on men, because women are more likely to be in the lower income strata. Other analysts also argue that the numerous policies aimed at discouraging car use may run counter to the transportation needs of women, particularly where complex, multi-destination trip making is required (Women's Planning Network Inc., 1995).

The disruption occasioned by a freeway reconstruction may be severe enough to trigger the reconsideration of habitual behavior, and thus another literature relevant to this study deals with voluntary behavior change, and/or habit disruption. Research on voluntary behavior change is often directed to reducing the use of private motor vehicles in urban areas (Taylor et al., 2003; Fujii and Taniguchi, 2005; Rose and Marfurt, 2007). In one study that investigated gender differences in travel mode changes, Rose and Marfurt (2007) found (using 2003/2004 Australia “Ride-to Work” annual event travel survey data) that female first-time transit riders were more likely (30%) than men (22%) to continue riding transit five months after the event. Finally, a third relevant literature deals with environmental concern and related behaviors. For example, Matthies et al. (2002), using a survey of 187 inhabitants of a German city, found that women were more likely than men to report an intention to reduce their car use, due to their stronger ecological norms and weaker car habits.

3 DATA COLLECTION

Since the study was conducted just a few weeks before the closure, there was not time to draw a rigorous, geographically-based random sample and recruit participants by mail. Instead, respondents were recruited via e-mail invitations, disseminated through numerous State agencies, the Fix I-5 listserv, Transportation Management Agencies, and a press release from the University of California, Davis. Given the ad hoc nature of the recruitment process, we can neither compute a response rate, nor expect a completely representative sample. It is likely that State workers are overrepresented, as well as internet-literate workers, workers with burdensome commutes, those heavily affected by the Fix, and those who made environmentally-beneficial behavior changes. However, self-employed and small-business workers are probably underrepresented, some of whom (together with the less computer-literate) may also have been heavily affected by the Fix, so biases in the sample are counteracting each other to an unknown extent.

Accordingly, the subsequent descriptive statistics should be viewed with caution. Nevertheless, we suggest that some data are better than no data, and we also believe that *comparisons* in the data should be largely robust (particularly the comparison of men and women). Thus, we encourage the reader to focus on trends, conditional relationships, and the model (which is a specific type of conditional relationship): in these cases, it is less critical to have a sample that is representative of the total population (Babbie, 1998).

Two internet-based surveys were administered during the period of the Fix: the first, hereafter referred to as the Wave 1 survey, sought information on behavior during the first closure of the freeway, of all lanes in the northbound direction (Monday, June 2 – Sunday, June 8, 2008, for our purposes). The second survey (Wave 2) addressed the first closure of the freeway in the southbound direction (June 16-22). Another paper (Ye et al., 2009) includes selected comparisons between the two waves, but the present paper will focus on comparisons by gender, without regard to wave. To avoid the complication of having a sizable fraction (about a third) of the sample not being independent across waves, in this analysis we have retained all of the Wave 1 cases (4520 after screening for completeness), and among the Wave 2 cases, only those who did not complete Wave 1 (2414), for a pooled sample of 6934 cases. The pooled sample contains 2247 (32%) men, 4160 (60%) women, and 527 (8%) respondents who declined to state their gender. The sizable proportion of women in the sample is not as unbalanced as it may seem, in view of the preponderance of State employees in our study population, and the fact that in general some 60% of state and local government workers are women (Caldwell, 2009).

TABLE 1 presents the sample statistics for some selected characteristics. The “average” characteristics are: age 47, female, college graduate, in a household with 2.7 members, 2.1 cars, and having an annual income of $75,000 - $99,999. Women tend to have lower (household) incomes than men, at least in part because on average they have less education, are slightly younger, are more likely to hold clerical positions, and are more likely to work part-time. They also tend to have smaller households (hence, generally fewer wage-earners). However, number of vehicles, and commute distances and times are relatively similar across gender.

We applied three filters to the data at various points in the analysis. (1) We excluded from the remainder of the analysis 344 respondents (118 men, 210 women, 16 unknown) who were out of the region for the entire week of the closure. (2) From the analysis of commuters’ active choices (Section 5), we additionally excluded 28 respondents (9 men, 19 women) who did not commute to work during the closure week. (3) Finally, from the model of the choice to increase transit use (Section 6) we further excluded 1123 respondents (406 men, 646 women) who already used transit for all or almost all of their commuting trips. The remaining sample for the “increase transit use” model is 5439 cases (1714 men, 3285 women).

TABLE 1 Selected Characteristics of the Sample, by Gender[a]

Characteristic (sample sizes)	Pooled data N (%)	Men N (%)	Women N (%)
Number of cases	6934 (100.0)	2247 (32.4)	4160 (60.0)
***Average age (years)** (6053, 2067, 3965)	46.5	47.3	46.1
***Average educational level** [b] (6291, 2192, 4038)	4.06	4.3	3.9
***Annual household income** (5977, 2112, 3817)			
Less than $15,000	29 (0.5)	14 (0.7)	15 (0.4)
$15,000-$29,999	106 (1.8)	25 (1.2)	80 (2.1)
$30,000-$44,999	493 (8.2)	112 (5.3)	374 (9.8)
$45,000-$59,999	715 (12.0)	176 (8.3)	535 (14.0)
$60,000-$74,999	1070 (17.9)	312 (14.8)	752 (19.7)
$75,000-$99,999	1243 (20.8)	490 (23.2)	740 (19.4)
$100,000 or more	2321 (38.8)	983 (46.5)	1321 (34.6)
***Average household size** (6328, 2184, 4092)	2.72	2.83	2.67
Driver's license possession (6387, 2215, 4109)	6333 (99.2)	2200 (99.3)	4071 (99.1)
***Average number of household operational vehicles** (5722, 1991, 3683)	2.08	2.17	2.03
***Distance from home to the nearest bus stop or light-rail station** (6356, 2210, 4081)			
Less than a 5-minute walk	1680 (26.4)	676 (30.6)	992 (24.3)
5 - 10-minute walk	1729 (27.2)	592 (26.8)	1123 (27.5)
10 – 20-minute walk	1042 (16.4)	352 (15.9)	674 (16.5)
More than a 20-minute walk	1501 (23.6)	482 (21.8)	1002 (24.6)
Don't know	404 (6.4)	108 (4.9)	290 (7.1)
***Average commute minutes** (6878, 2231, 4134)	31.9	32.8	31.4
***Average commute miles** (6872, 2231, 4130)	17.8	18.4	17.4
***Primary job work schedules** (6920, 2245, 4152)			
Part time [c]	388 (5.6)	84 (3.7)	274 (6.6)
Conventional [d]	3221 (46.5)	1065 (47.4)	1899 (45.7)
Variable [e]	1461 (21.1)	509 (22.7)	858 (20.7)
Compressed 9-80 work week [f]	1504 (21.7)	470 (20.9)	921 (22.2)
Compressed 4-40 work week [g]	261 (3.8)	82 (3.7)	158 (3.8)
Other	85 (1.2)	35 (1.6)	42 (1.0)
***Occupation** (6914, 2242, 4150)			
Manager/ administration	1591 (23.0)	541 (24.1)	929 (22.4)
Professional/ technical	3929 (56.8)	1432 (63.9)	2211 (53.3)
Services/ repair	47 (0.7)	29 (1.3)	13 (0.3)
Clerical/ administrative support	1184 (17.1)	175 (7.8)	916 (22.1)
Sales/ marketing	71 (1.0)	20 (0.9)	43 (1.0)
Production /construction/ crafts	42 (0.6)	27 (1.2)	12 (0.3)
Other	50 (0.7)	18 (0.8)	26 (0.6)
***Number using transit as primary commute mode (6595, 2160, 3945)**	1183 (17.9)	484 (21.5)	609 (14.6)
Number currently using transit but not primary commute mode (6595, 2160, 3954)	1098 (16.6)	368 (16.4)	654 (15.7)
Awareness of Fix strategy that increase number of buses (6544, 2228, 4116)	3798 (58.0)	1291 (57.9)	2397 (58.2)

Employer-provided reduced-rate transit passes (6575, 2236, 4139)	4122 (62.7)	1383 (61.9)	2636 (63.7)
Employer-provided variable start/ end times (6575, 2236, 4139)	4109 (62.5)	1376 (61.5)	2617 (63.2)

[a] Traits that differ significantly by gender (at the 0.05 level or better) are marked with a "*" in front.
[b] 1=Some grade or high school; 2=High school graduate; 3=Some college or technical school; 4=Four-year college, university, or technical school graduate; 5=Some graduate school; 6=Completed graduate degree(s).
[c] Less than 35 hours per week.
[d] 7 ½ - 8 hours per day, with a start time between 8:00 and 9:00 a.m.
[e] 7 ½ - 8 hours per day, with a variable start time.
[f] 9-hour days, for nine days in two weeks.
[g] 10-hour days, for four days each week.

4 BASELINE WORK SCHEDULE/COMMUTE CHARACTERISTICS

Information on respondents' baseline work schedule/commute patterns was collected through a series of questions focusing on a "typical 28-day (4-week) period", "before Fix I-5 began". We asked for the number of days out of 28 on which respondents:

- worked at home as the regular location of their job;
- worked at home instead of commuting to their regular workplace; and
- physically traveled to a regular workplace outside of their home.

Those with a non-zero answer to the last question were asked how many days out of that number they

- drove alone for most of the commute;
- carpooled or vanpooled for most of the commute;
- rode a bus for any portion of the commute;
- rode light rail for any portion of the commute;
- rode Amtrak (commuter train) for any portion of the commute;
- walked for the entire commute; and
- rode a bicycle for any portion of the commute.

Thus, only the drive alone, car/vanpool, and walk modes are mutually exclusive, and walking (for the entire commute) in principle excludes any other mode. The transit and bicycle modes can occur in any combination with each other or with the car modes. Accordingly, the sum of the mode-specific answers can exceed the total number of commute days for a given respondent.

We analyzed the sample's baseline participation in each of these commute options, together with compressed work schedules since they also reduce the number of vehicle commute-miles traveled (for more details, see Mokhtarian et al., in progress). Engagement (at least one day out of 28) in compressed work schedules (26%), both types of working at home (5% as regular workplace; 9% telecommuting), and physical commuting (97%) is relatively similar across gender; the main differences appear with respect to mode choice. Women are considerably more likely than men to drive alone (75% versus 68%). Women are also slightly more likely to car/vanpool. But (in contrast to Pisarski, 2006) they are substantially *less* likely to use transit (30% versus 34%), as well as less likely to bicycle (6% versus 18%) or walk (2% versus 3%).

Computing the average share of physical commute days on which each mode is used – the measure closest to a true commute mode split available in our sample – reveals that the drive alone share is relatively small at 55%, with car/vanpooling at 18%, transit around 25%, and walking and biking about 7% (combined). These shares are quite different from those in the region as a whole, which are 82%, 10%, 3%, and 5%, respectively (SACOG, 2008). However, the latter set of shares is for all passenger trips during the weekday peak, whereas ours are for commuting only (and disproportionately downtown-oriented), but without regard to time of day.

5 COMMUTE-RELATED ACTIVE CHOICES

The literature identifies a number of possible active choices that can be made in these circumstances (Giuliano, 1992; Möser and Bamberg, 2007, Shiftan and Suhrbier, 2002). In the subsections below, we respectively discuss making fewer commute trips (via telecommuting, alternative work schedules, and/or vacation), changing mode, and changing departure time or route. An analysis of teleconferencing and non- work-related trips can be found in Mokhtarian et al. (in progress). As discussed above, this portion of the analysis excludes respondents who did not commute at all during the closure week.

5.1 Making Fewer Commute Trips

Respondents were asked whether, during the closure week, they made "fewer commute trips than you normally would", with response options "Yes, because of Fix I-5", "Yes, for some other reason", and "No". We discuss only the changes made because of the Fix. Some 14.1% of respondents made fewer commute trips (because of the Fix) during the closure week (see TABLE 2). We estimate (see Mokhtarian et al., in progress for details) that increased telecommuting, compressed work schedules, and vacation days were adopted by about 5.6%, 3.1%, and 3.1% of the sample, respectively.

Women were significantly more likely than men to reduce their commute travel because of the Fix (15% versus 11%); interestingly, however, they were about 16% less likely than men to do so by compressing their work schedules (in contrast to Mokhtarian, et al., 1997). Instead, women were more likely than men to reduce their commute travel by taking some vacation days (28% versus 23%).

5.2 Changing Modes

Respondents were asked whether, during the closure week, they traveled "to or from work using a different means of transportation than you normally would", with the same response options as in Section 5.1. Again, we analyze only the changes made because of the Fix. Respondents reporting such changes were then asked which mode(s) they used on more occasions than normal, and what they would have ordinarily done on those days (multiple answers were possible, for both questions).

The vast majority (at least 93%) of those making commute mode changes increased their use of more sustainable modes, most often at the expense of driving alone. Increasing transit use was the most common change: 64.9% of those who altered their commute mode patterns made that choice (5.3% of the total eligible respondents), among which 70.1% would otherwise have driven alone to work. About 2.5% of eligible respondents increased their walking or biking, and 1.4% increased ridesharing; only 0.6% increased driving alone.

There are substantial differences in these patterns by gender, however. Taking all modes together, women were 16% more likely to change modes (8.1%) than men (7.0%). Among

TABLE 2 Commuters' Work-Trip-Related Active Choices, by Gender[a]

Number making these choices (sample sizes)	Pooled data N (%)	Men N (%)	Women N (%)	Average number of times (by those who made this choice)	Pooled data	Men	Women
*Made fewer commute trips (6552, 2118, 3925)	923 (14.1)	240 (11.3)	578 (14.8)				
Made fewer work-related trips (6552, 2118, 3925) [b]	3 (0.1)	1 (0.0)	2 (0.1)				
Made fewer trips, trip purpose not specified (6552, 2118, 3925) [c]	36 (0.5)	10 (0.5)	24 (0.6)				
Means of avoiding the commute trips (627, 180, 391) [d]				Means of avoiding the commute trips (433, 125, 271)	2.63	2.56	2.59
Telecommuted	297 (47.4)	85 (47.2)	186 (47.6)	Days avoided commuting by telecommuting (290, 84, 182)	2.17	2.24	2.04
Adopted compressed work week	163 (26.0)	52 (28.9)	95 (24.3)	Days avoided commuting by compressed work week (157, 51, 93)	2.92 [e]	2.63 [e]	3.01 [e]
Took some vacation	165 (26.3)	42 (23.3)	109 (27.9)	Days avoided commuting by taking vacation (99, 26, 63)	1.80	1.73	1.83
Other	2 (0.3)	1 (0.6)	1 (0.3)				
Missing responses for means of avoiding the commute trips [f] (923, 240, 578)	315 (34.1)	75 (31.3)	192 (33.2)				
Changed mode (6356, 2073, 3837)	493 (7.8)	148 (7.0)	318 (8.1)				
*Avoided rush hour (5506, 1745, 3428)	2642 (48.0)	751 (43.0)	1725 (50.3)	Days avoided rush hour	3.90	3.87	3.91
*Changed route (5254, 1650, 3282)	2371 (45.1)	681 (41.3)	1540 (46.9)	Days changed route	3.44	3.40	3.45

[a] Traits that differ significantly by gender (at the 0.05 level or better) are marked with a "*" in front.
[b] The survey directly asked about changes to commute trips and to non-work trips, but not about changes to (non-commute) work trips (such as business meetings). The responses reported here were obtained from write-in descriptions to the "other (please specify)" option on the commute reduction question described in footnote c. As such, they certainly understate the actual level of changes made to non-commute work trips in the sample, and are included here only for completeness.
[c] These responses were also write-ins to the "other (please specify)" option on the commute reduction question.
[d] During the week of [June 2-8 or June 16-22] (Mon-Sun)… … , how did you avoid the commute trips that you would have otherwise made? (Options: Telecommuted to work; Adopted a compressed work week; Took vacation time; Other). Categories are not mutually exclusive.
[e] This unexpectedly high average suggests that a number of respondents failed to read the word "avoid" in the question ("how many days did you avoid physically travelling to and from work by …"), and responded with the number of days they commuted to work. The same could be true of the telecommuting and vacation strategies, as well.
[f] Cases which reported they made fewer commute trips but did not indicate how they avoided the commute trips.

changers, women were considerably more likely than men to increase their use of transit (73% versus 58%) and car/vanpooling (20% versus 12%), and much less likely to increase bicycling or walking (21% versus 49%).

5.3 Changing Departure Time or Route

The active choices discussed so far are considered to be potentially somewhat costly, in that they may require lifestyle adjustments and/or affect other people (Salomon and Mokhtarian, 1997). By contrast, the remaining changes shown in TABLE 2 are considered relatively low-cost, entailing minimal change to established patterns. Accordingly, a number of studies have found such changes to be the most common responses to increasing congestion or disrupted commute patterns (Mokhtarian et al., 1997), and the present analysis is no exception. Nearly half the respondents reported making a special effort to avoid rush hour during the closure week (on an average of four days out of the week), and 44% of those driving/carpooling to work that week reported making planned changes to their commute route (on an average of 3.4 days). Women are considerably more likely than men to employ each of those strategies, consistent with the findings of Mokhtarian et al. (1997) for changing departure time.

Altogether, about 60% of respondents adopted at least one of the active changes to the commute that have been analyzed in Section 5. However, women were 21% more likely to make at least one change than men were (64% versus 53%). At least two explanations for this greater activism on the part of women present themselves. The first is that women were more adversely impacted by the Fix, and thus had a greater need to make a change. Mokhtarian et al. (in progress) found that women were more likely than men to report passive impacts, both good and bad, due to the Fix. The greater reported incidence of negative impacts on women lends credence to the idea that they had a greater *external* motivation to make changes. The second explanation is that women may have a greater *internal* motivation to make changes, i.e. that they may be more inclined to make socially/environmentally beneficial changes to their commute in general. This interpretation is consistent with the independent findings of Matthies et al. (2002) and Rose and Marfurt (2007) discussed in Section 2.

6 THE "INCREASE TRANSIT USE" MODEL

Although it is helpful to see descriptive statistics on how commonly various changes were made, it is also desirable to better understand the types of people who make a given change. This is perhaps best done in the context of a model, in which multiple covariates can be controlled for simultaneously. Space does not permit providing models for all the changes we see in our sample, but we present a model for the most commonly-chosen change that reduces vehicle travel, namely the choice to increase the use of transit for commuting.

The dependent variable is created from the survey question which asks (of those who previously indicated "travel[ing] to or from work using a different means of transportation [during the closure week] than you normally would", because of the Fix), "During the week of … which did you use on more occasions than you normally would have?" with seven possible response options: "Carpool or vanpool", "Bus", "Light rail", "Amtrak train", "Walking or biking", "Driving alone", and "None of the above". In our model, we combine "Bus", "Light rail" and "Amtrak train" into a single "transit" variable, equal to 1 if respondents selected any of those modes, and 0 otherwise. Among the "0" respondents we include those who did not change modes because of the Fix, based on the previous question, but exclude those who (1) were out of the region the entire week, (2) did not travel to work any days that week, or (3) already take transit for all or almost all of their commute trips, since in none of those cases would increasing transit use be a feasible option. This left 5439 cases, including 249 (4.6%) who increased their transit use due to the Fix. A number of potential explanatory variables are available, including sociodemographic traits and the availability of various employer-based commute modification instruments.

To identify gender-related differences in the choice to increase transit use, we first developed best models for each gender separately, and for the pooled sample. Based on those models, we created a fully gender-specific single model (i.e. a single equation in which every variable was interacted with gender, so that coefficients of each variable could differ by gender). Then, as indicated by statistical tests and conceptual considerations, we deleted insignificant variables and constrained coefficients to be equal across genders, resulting in a final hybrid model in which some coefficients are gender-specific while others are based on the pooled sample. The final sample necessarily excludes cases where gender was not reported.

Due to missing data on gender and other variables, our preferred model (TABLE 3) has 214 (4.6%) respondents who increased their transit use during the closure week and 4422 who did not. Overall, as mentioned in Section 5.2, women were considerably (45%) more likely than men to increase their use of transit (6.1% versus 4.2% in the final estimation sample), perhaps because, using it less than men to start with (Section 4), they had more room to do so.

The ρ^2 goodness-of-fit measure (Ben-Akiva and Lerman, 1985), with the equally-likely model as base, is 0.766, which, taken at face value, is considered quite good in the context of disaggregate discrete choice models. With shares this unbalanced, however, the market-share model alone (the model containing just the constant term) has a ρ^2 value of 0.730, initially suggesting that the true explanatory variables only add 0.036 to the goodness of fit. However, the final model is significantly better than the market-share model (χ^2 = 232 with 7 d.f., p=0.000). Further, when we re-estimate the same model except without the constant term (not shown), we find a ρ^2 value of 0.499, which indicates that most (65%) of the explanatory power of the full model lies in the "true" variables. That is, the true variables are substantively helping to explain *why* the shares are so unbalanced.

Seven variables besides the constant are retained in the model: two mode usage variables, one awareness variable, two employer strategies (gender-specific), and two (gender-specific) sociodemographic variables. We discuss each of these in turn.

We hypothesized that people who (had) already used transit to some extent would be more likely to increase their use of it than others would be to start using it. Accordingly, we tested several indicators of transit use. Two dummy variables, marking those who use transit as their primary commute mode and those who currently use transit but do not have it as their primary commute mode, are strongly significant and positive, as expected. Our interpretation is that people who currently use transit are familiar with the schedule, stop/station locations, and riding experience, and would therefore find it easier to step up their use. However, those who already use transit as their primary commute mode have less room to increase their use than respondents who currently use transit but do not have it as their primary commute mode. By contrast, nonusers may have already firmly concluded that transit is not suitable for their needs, whether based on erroneous impressions (e.g. an overestimation of travel time by transit, as found by Fujii et al., 2001 and van Exel and Rietveld, 2010), or accurate ones.

TABLE 3 Binary Logit Model of Increased Transit Use, Pooled Data (1=Increased transit use, 0=Did not increase transit use)

Variable	Coefficient	P-value
Constant	-4.302	0.000
Sociodemographics		
Household size (female)	0.120	0.019
Manager/administration occupation (male)	0.644	0.022
Transit usage		
Use transit as primary mode	1.350	0.000
Currently use transit but not primary mode	2.229	0.000
Awareness of Fix impact mitigation strategies		
Increased number of buses	0.378	0.027
Employer-provided commute strategies		
Reduced-rate transit passes (female)	0.569	0.002
Variable start/end times (female)	-0.434	0.013
Valid number of cases, N	4636 (yes: 214; no: 4422)	
Final log-likelihood, $LL(\beta)$	-751.21	
Log-likelihood for market share model, $LL(MS)$	-867.168	
Log-likelihood for equally-likely (EL) model, $LL(0)$	-3213.43	
No. of explanatory variables, K (including constant)	8	
$\rho^2_{ELbase} = 1 - LL(\beta)/LL(0)$	0.766	
Adjusted $\rho^2_{ELbase} = 1 - [LL(\beta) - K]/LL(0)$	0.764	
$\rho^2_{MSbase} = 1 - LL(\beta)/LL(MS)$	0.134	
$\rho^2_{MS} = 1 - LL(MS)/LL(0)$	0.730	
χ^2 (between the final model and the EL model)	4924.44	
χ^2 (between the final model and the MS model)	231.916	

It is valuable to realize that it may be more effective to try to persuade current transit users to increase their use than to try to convince nonusers to switch – although we recognize that both potential markets are important. On the other hand, it could also be argued that including user history variables are not as insightful as identifying the "first principles" that influence whether one does currently use transit or not, and including those in the model instead. Thus, we also tested excluding these two variables from the model (results not shown). In the best alternative model, the only difference is that the female-specific household size variable also dropped out, and the ρ^2 value fell to 0.73. This indicates that the transit experience variables are not dominating the explanatory power of the model.

One awareness variable is significant in our model, with the expected sign: it is unsurprising that respondents who had heard about the increased number of buses are more likely to increase their transit use.

Two employer strategies are significant in our preferred model, with expected signs. Not surprisingly, the availability of reduced-rate transit passes substantially increases the probability of using transit more, but it is interesting that this is only the case for women, while the availability of reduced fares has no significant effect on men. It is possible that men's higher incomes make them less sensitive to transit costs. Similarly, the availability of flextime decreases the propensity to increase transit use, but again only for women. The interpretation of the latter result is that if people can change their departure times to avoid congestion caused by the Fix, then their current commute mode may remain viable and they have less incentive to switch to transit. This may be true for women but not for men for the same reasons leading fewer women than men to use transit in normal times.

Finally, two gender-specific sociodemographic traits are also significant. Men in managerial/administrative occupations are substantially more likely to increase their use of transit than are other groups. It is possible that men in high-end white-collar occupation are more likely to live in locations better-served by commuter train, light rail, and express bus service. The positive coefficient of household size (for women only) was initially unexpected, but is also saying something meaningful. We assume that people in larger households have more complex activity-travel patterns, and therefore our original expectation was that commuters in such households would be more likely to find the car to be most practical, and more likely to stick with the car. However, further reflection and comments on open-ended questions of the survey suggest another possibility. It may be that the more complex patterns of larger households are more vulnerable to disruption, and have less ability to absorb a disruption without much change. Thus, commuters in larger households may have a greater *need* to change than those in single- or two-adult households, while at the same time; there might be more limitations on the ability of such commuters to choose other actions such as changing route or departure time. The fact that the variable is significant only for women suggests that it may also reflect an income effect, as women in smaller households are more likely to be single mothers.

Besides the seven variables just discussed, we tested a number of other variables, including work schedule type, commute time and distance, the distance of the nearest bus stop or light rail station from home, income, number of vehicles per household member and per licensed driver, and a geographically-based indicator of how strongly the respondent's commute might have been affected by the Fix. However, none of these variables were significant in the final model.

7 SUMMARY AND SUGGESTIONS FOR FUTURE RESEARCH

This study offers a preliminary analysis of commuters' responses to the Fix I-5 reconstruction project, focusing on gender differences. The easiest options (such as avoiding rush hour, adopted by 48%, and changing route, 45%) were the most common responses, and women were considerably more likely than men to employ each of those strategies. About 8% of eligible respondents altered their commute mode choices during the closure week. The vast majority (93%) of those increased their use of more sustainable modes, most often at the expense of driving alone. Increasing transit use was the most common change (made by 5.3% of the eligible respondents), and there were substantial differences in mode change patterns by gender (with women considerably more likely than men to increase their use of transit and car/vanpooling). Overall, women were more likely to make at least one change (64%) than men were (53%).

A binary logit model was built to better understand the choice to increase transit use (the most popular VMT-reducing option) during the Fix. Two mode usage variables, one awareness variable, two employer strategies (gender-specific), and two (gender-specific) sociodemographic variables were significant. Being a current transit commuter positively influenced the propensity to increase transit use, suggesting that persuading current transit users to increase their use may be easier than convincing nonusers to switch to transit. The availability of reduced-rate transit passes and flextime decreased the propensity to increase transit use, but only for women. The latter result in particular illustrates the conflict that sometimes arises among policy instruments: making work hours more flexible is considered beneficial for reducing congestion and for balancing work and family needs, but the increased flexibility in avoiding peak-period congestion may enhance the appeal of continuing to commute by driving alone. Finally, men in managerial/administrative occupations, and women in larger households, were more likely to increase their use of transit. We interpret the latter result to reflect a greater vulnerability to disruption of the complex activity patterns in larger households, with the result that commuters in such households have a stronger impetus to make a change when disruption occurs.

Several directions for future research are indicated. Using the same data set, we can model not only other behavioral changes beyond the one explored here (increased transit use), but also the reported likelihood of continuing to use a strategy adopted (or increased) during the Fix. With the addition of geocoded home and work location information (for those who reported nearby street intersections), we can explore a number of geographic relationships with observed outcomes. Ultimately, we will be merging the attitudinal and behavioral data collected in Wave 3 with Waves 1 and 2, to provide a rich basis from which to further investigate the persistence of behavioral changes prompted by the Fix.

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